

28 July 2005

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For submission to FISHERIES OCEANOGRAPHY, ALEUTIAN ISLANDS

SUPPLEMENT

## **Introduction to Processes Controlling Variability in Productivity and Ecosystem Structure of the Aleutian Archipelago**

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Running title: Introduction

## PURPOSE

This special issue provides the first comprehensive, interdisciplinary examination of the marine ecosystem of the eastern and central Aleutian Archipelago - an area that is susceptible to climate shifts, anthropogenic influences and ecosystem change. Relatively little focused research had been conducted in this region before the studies presented here. The earlier foundation of knowledge was largely from efforts of the National Marine Fisheries Service and the Outer Continental Shelf Environmental Assessment Program.

Present investigations of the ecosystem of the Aleutian Islands were instigated by a marked decline in the western stock of Steller sea lions (*Eumetopias jubatus*) from more than 250,000 in the 1970s to less than 50,000 in the early 1990s. This decline resulted in the western stock of Steller sea lions being declared threatened in April 1990. The cause of their decline was not known, but the most likely mechanisms included: climate shifts, direct or indirect effects of fisheries, diseases, and top-down control through predation by killer whales. As part of the effort to evaluate these competing hypotheses and to understand why sea lion numbers continued to decline, congress enacted legislation in 2001. That legislation funded investigations of the possible causes of the decline in abundance of the western stock of Steller sea lions that live from Kodiak Island in the Gulf of Alaska westward to and including the Aleutian Islands.

The focus of this supplementary volume is the eastern and central Aleutian Archipelago (162°W to 177°W), which is a critical habitat for the western stock of the Steller sea lion population and also where their decline has been the greatest. Many papers in this volume present results from just two cruises on the R/V *Alpha Helix*, one in 2001 and the second in 2002. These cruises were funded by the Steller Sea Lion Program, directly and through NOAA's Coastal Ocean Program. While the original focus of the volume was on Steller sea lions and the findings of these cruises, the volume soon extended beyond just sea lions and resulted in the first integrated ecosystem study of the waters surrounding the

Aleutian Islands.

Drs. J. Schumacher and G. Kruse consented to contribute their time and expertise as guest editors. While both of them are knowledgeable of regional issues, they were not part of any Aleutian research team. Thus, they could be objective in judging the quality and content of manuscripts submitted for publication in this supplement. Rather than delivering the more typical editorial discussing the impact of this supplement on marine science, they elected to contribute a unique editorial on the importance of sustaining the ecosystem services of the Aleutian Archipelago. In their article, they call for development of an integrated ecosystem management plan that would involve the major agencies and stakeholders that are active in the region. This valuable addition thus recognizes and amplifies the important and timely theme of adopting an ecosystem approach to resource management.

## **IMPORTANCE AND IMPACT**

While there have been a number of isolated, historical studies of the marine ecosystem of the eastern and central Aleutian Archipelago, the results presented in this volume represent the first integrated ecosystem study of this productive region. In addition to observations on physical, chemical and lower trophic level characteristics of the region, papers are presented on unique, cold-water corals that have colonized many of the Aleutian Passes, on the paleoclimate of the North Pacific, and on studies of the fish, birds and mammals that inhabit this region.

Major findings include a better understanding of the mechanisms that control flow through the passes and the magnitude of that flow; the importance of the medium-size passes (water depth between 130 and 200 m) in supplying nutrients to the Bering Sea euphotic zone; the importance of the small and medium-size passes in providing foraging for birds and mammals; recognition that the Aleutians may support the greatest abundance and diversity of cold-water corals in the world; and, that during the last millennia, climate variability has affected the ecosystem on many occasions.

A single integrating factor was found: a partitioning of ecosystem characteristics occurs at Samalga Pass. Aleutian passes to the east of Samalga are more shelf-like in nature, and those to the west are more oceanic. Specifically, east of Samalga Pass there are mainly neritic zooplankton species, which support short-tailed shearwaters and high numbers of fish species. In contrast, west of Samalga there are mainly oceanic zooplankton, which provide food for northern fulmars and auklets, and fewer fish species. Euphausiids are important in diets of fish to the east of Samalga Pass, while copepods and myctophids are important in fish diets to the west. Similarly, pollock are the major prey of sea lions in the eastern part of the study area, and Atka mackerel fill that role to the west.

There is also a marked division in the distribution of sperm whales, with none found east of the pass, and a greater diversity of cold-water corals and sponges found west of Samalga Pass.

While this volume provides the best description and discussion of the eastern and central passes presently available, there remain many as yet unanswered questions. How will climate variability or regime shifts impact this narrow band of islands, especially any north-south shift in the predominant weather patterns of the region? Will any shift in the weather patterns result in a change in the transport of warm, nutrient-rich water through the passes, thus influencing the ecosystems of the Bering Sea? How will the large population of cold-water corals and sponges adjust to any change? The western stock of sea lions appears to have stabilized. Will they recover? It is our hope that the papers assembled in this volume will provide a solid basis on which to build future research and a source of new questions and hypotheses with which to structure future investigations.

It is not enough to wait for further studies to provide answers to these questions. The existing body of knowledge needs to be incorporated into an overall plan for resource management that goes beyond the traditional interest of commercial fisheries. State and federal regulatory agencies must coordinate with other stakeholders (commercial and recreational fishers, subsistence users, oil and gas developers, shipping and tourism interests, etc.) to insure that the rich marine productivity and biodiversity of the Aleutian Archipelago is sustained.

## ACKNOWLEDGEMENTS

We acknowledge Blackwell Publishing and staff for helping us to bring this supplement to press. Dr. David Checkley, Editor-in-Chief of *Fisheries Oceanography*, was supportive of this endeavor and helpful in bringing it to pass. We are indebted to our guest editors, Drs. J. Schumacher (a.k.a. Two Crow) and G. Kruse, for their many hours of labor. For research support, we are grateful to the NOAA Steller Sea Lion Program, the NOAA Coastal Ocean Program, Fisheries-Oceanography Coordinated Investigations, and the Arctic Section of the National Science Foundation. We thank the Cooperative Institute for Arctic Research at the University of Alaska Fairbanks, and the Joint Institute for Marine Observations at the University of California, San Diego, for their roles in facilitating this research. In particular, we acknowledge Dr. Elizabeth Turner, NOAA Coastal Ocean Program, for partial funding for this supplement. Finally, many of the results presented here would not have been possible without the dedicated and skilled services of the crew and officers of the R/V *Alpha Helix* and the NOAA ship *Miller Freeman*. This research was sponsored by NOAA's Coastal Ocean Program and the Steller Sea Lion Research Program, and is contribution FOCI-L564 to Fisheries-Oceanography Coordinated Investigations and contribution 2845 to the Pacific Marine Environmental Laboratory.